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Improving Dyslexic Children's Learning Experience

by

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Abstract

Reading and writing are fundamental skills for every child to be successful in our society. With developmental dyslexia (simply referred to dyslexia hereon in) affecting numerous Canadians, the need is there to make sure every child is able to read and write well. Young dyslexic children aged eight to twelve, are especially prone to experiencing the frustrations learning to read gives. While there is assistive technology for helping the children read, comprehend what is being read, and speech to text softwares - these really only assist the children, rather than teach them proper literacy skills. Through interviews, observational studies of 1:1 tutoring sessions, and previous scholarly research, this thesis is intended on providing an evidence based multisensory design to help struggling dyslexic students reach their full potential. The final solution, ReCess, will bring specialized education directly to the schools, where it is accessible to all dyslexic students.

Keywords: Dyslexia, children, reading, multisensory

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CHAPTER 1 - Problem Definition



Figure 1 - Dyslexia in Children, https://invisioncare.com/dyslexia-in-children/

Introduction

The purpose of this chapter is to define the thesis problem. This is needed as it will be the beacon that defines the thesis, and will become a guide to keep referencing back to. Having this initial problem area will allow for preliminary information to be gathered, determine the key information to be gathered, and have the key questions to be asked. Lastly, a general history, with social contexts and backgrounds will be included to set the scene.

1.1 Problem Definition

The learning disability of dyslexia affects 15% - 20% of Canada's population (Dyslexia Canada, n.d.). Dyslexic children aged eight to twelve struggling to learn to read and write properly are often left to the minimal support from the grade schools. While the child's parents, or caregivers, may search for afterschool dyslexic learning centers for support, these are rare and often have long waiting lists. Diagnosing dyslexia from the earliest of ages is key to addressing it - and this ultimately allows for "rewiring" of the students brain to begin earlier. If dyslexia is not addressed at this early stage, then the repercussions of struggling to read for the children are snowballed into their teenage and young adult years. The feeling of not making traditional progress, similar to that of their peers, adds stress and anxiety, especially when their name is called upon to read aloud in front of their peers. This is when low self esteem starts to creep in. Understanding this problem, there are currently no products that are designed to support dyslexic children while they wait for a learning center to admit them. The opportunity to design a system of products that can be used to assist the dyslexic child is there, and is what this thesis is focused on solving.

1.2 Rationale & Significance

Key Information to be Determined

The current methods of supporting and teaching dyslexics, along with the readily availability of these sources, needs to be determined to understand the current environment. The effectiveness of these methods, and how well they work, will be determined. As well, investigating the current school systems ability to help dyslexics, will lay the groundwork and will be used as a guide to compare to. Having an idea as to how the dyslexic students like to learn and play will also be an important area of significance. *Key Questions to be Answered*

The kinds of products, availability, and the quality of current assistive technology products that dyslexic children use needs to be asked. What key features about these products do they like and dislike? Perhaps they do not use any products because the student does not find any benefit from them.

Along with these products, learning centers play a crucial role in the students' development. Why then, is there a shortage of tutors and why is it so commonplace to have to look for help outside of a child's school?

1.3 Background, History & Social Context

Hearing the word dyslexia, often the thought of jumbled letters and struggling and frustrated children comes to mind. With the diagnosis of dyslexia often occuring between the ages of five to twelve. Dyslexia is a neurological condition which is developed during fetal development, often due to family

genetics. While dyslexia is not "cure-able" by definition, dyslexics develop strategies to help ease the symptoms. Their character is often described as being hard workers, resilient and problem solvers. While their way of preferred learning is commonly multisensory, tactile and visual.

Many current methods for assisting dyslexic children learning to read revolve around out of school learning centers. Often these learning centers use the science based Orton-Gillingham approach to teaching phonics and word decoding. This approach is taught by trained tutors, but is heavily waitlisted for the children. In contrast, many existing digital or physical products help to alleviate the symptoms of dyslexia, compared to addressing the root cause of the problem - phonics.

Summary

Dyslexia can affect many children throughout grade school education. Understanding that there is no current in school support for students, forces the student and their parents to look on their own elsewhere. Often these children are put on a long wait list for afterschool programs that use the Orton-Gillingham approach to learning to read. This practice uses repetition and tactile methods to rewire the students brain. Current assistive products are not designed to teach a student as well as these private 1:1 tutoring sessions.

CHAPTER 2 - User Research

Introduction

Chapter 2 focuses on the research of the user and existing products. Getting an understanding of who will actually use the product, allows for a more indepth and meaningful design investigation. Researching current products gives better knowledge of what is working and what does not.

2.1 User Research

The purpose of this section is to describe the organized methods of research that were conducted, including the results of the findings. This encompasses a persona, current methods and techniques, and will be visually displayed in an activity map. Following the persona will be product benchmarking with current market trends. The research stage is paramount to the development of an evidence based concept.

2.1.1 User Profile - Persona

There are many different people that help the young dyslexic grow and learn. These people can include their parents/guardians, teachers, resource teachers, learning center tutors and siblings. The user profile allows for a more focused look at the typical demographics that experience dyslexia.

Triangulation of Use



Figure 2 - Triangulation of Use

Primary User: Dyslexic student Secondary Users: Resource teachers, tutors Trierary Users: IT staff, administrators

Demographics

The search for demographics related to dyslexic youth occurred by means of searching Humber Libraries and Google. As well, the thesis advisor was able to assist in providing valuable statistics. The following search terms used online were:

- "Dyslexia Demographics"
- "Dyslexic Children Demographics"
- "Dyslexia Statistics"

Findings: Based on the online demographic search the following categories are being used to organize the information; Age, Gender, Ethnicity, Income (parents), Education and Personality.

Age: Dyslexia is a neurological condition that the child develops in the womb of the mother. Once you are identified to be dyslexic you can not "grow out of it". Dyslexics are usually diagnosed in childhood between the ages of five to twelve - as a result of poor reading and writing performance in school.

Gender: While the initial thought may be that dyslexia is known to be more prevalent in males than females, this is not entirely true. They are both equally able to have dyslexia, however it is just that in the classroom setting, males tend to be more rambunctious than females - thus drawing more attention from the teachers, and perhaps testing for learning disabilities (Shaywitz, 2003).

Ethnicity: Unfortunately, people of a minority are less likely to be identified as dyslexic and receive the help they need when compared to a similar more fortunate child (Knight et al., 2021). Additionally, people with an Asian, Indian, or otherwise mixed background, are less likely to have dyslexia (Knight et al., 2021).

Income: Parental income plays a role in the labeling of a child as dyslexic. Families with a higher income are able to provide the child with testing opportunities - as testing often comes as a large expense.

Education: While education is how a dyslexic learns to develop strong strategies for coping, it is not till a dyslexic is proven, via diagnosis, that they will receive extra help. This usually occurs in the earlier years of schooling (i.e. primary to grade 7).

Personality: Dyslexics are known to be hard workers, the reason being because they tend to have to work a little longer at things to fully comprehend. They are known to be sociable and live an active lifestyle. They are methodical, again alluding to the drive to fully understanding concepts. While they can focus on details, they are also known to be able to see the larger picture, or understand the gist of topics.

User Behaviour

User behaviour was conducted in the same manner as the search for demographic information.

Findings: While dyslexics are in need of extra help, it is rare to come of. They go to school, do the best they can while in class and go to extra help outside of class time. They are active people who enjoy playing sports and socializing. Classes such as physical education, science are favourites because they get to be active and learn in a hands-on manner. While they may get bogged down in the science lingo, they enjoy the class and understand the gist of the topics. They particularly like to work in groups because then they can get a better understanding of concepts with the help of others. They are methodical and have strong natural intuition.

Demographics		User Be	ehaviour	Personality	Cognitive Abilities
Age	8-12	Level of Focus	Average for age	Active lifestyle	Gets the gist
Gender	Primarily Male	Sociability	1-3 strong friends	Intuitive	Multisensory learner
Culture / Ethnicity	Caucasian	Work Ethic	Strong	Methodical	
Income (parents)	Middle Class (\$50,000 - \$80,000)				
Education	Grade 3-6				

Table 1 - Demographics & User Behaviour

Improving Dyslexic Children's Learning Experience

Persona



Name: Duncan Dice Age: 12 Gender: Male Ethnicity: Caucasian Income (parents): \$80,000 Education: Grade 6

Figure 3 -

https://images.unsplash.com/photo-1605783313291-1b996e9e7376?ixlib=rb-4.0.3&ixid=MnwxMjA3fDB8MHxzZWFyY2h8M3x8MTll MjB5ZWFyJTIwb2xkJTIwYm95fGVufDB8fDB8fA%3D%3D&auto=format&fit=crop&w=500&q=60

- 12 year old
- Has supportive parents
- Goes to public school
- Gets some help reading at school
- Can understand and get the gist of topics easily
- Struggles to read
- On a learning center wait list

Duncan is a 12 year old student at a public school in Halifax. He has supportive parents who know Duncan is dyslexic from a diagnosis three years ago. Unfortunately, Duncan is not able to receive the help he needs because of long waitlists at their nearest learning center. He feels embarrassed about his poor reading abilities, especially when they are in class with everyone else who is much stronger than he is. While he may not be able to read well, he is able to understand the gist of his other subjects at school and fairs better when he is listening and has the slide notes printed out.

Duncan's parents feel bad for not being able to support their son in reading and spelling. They don't think the school is doing enough for him, and the waitlist for getting private tutoring is long, not to mention expensive.

Although Duncan is struggling, he is optimistic about his future and thinks that once he is able to read more easily, he will be successful wherever he is.

2.1.2 Current User Practice

Through the use of surveys with dyslexic students, tutors, and parents and expert interviews this allowed for the creation of the following typical procedure a dyslexic goes through while in their youth.

Improving Dyslexic Children's Learning Experience



Figure 4 - Traditional Journey of a Fortunate Dyslexic

The figure represents a somewhat fortunate dyslexic child. They are able to get help from outside of school quickly - without much of a wait for admission to a learning center. However, there are many young students who are less fortunate and rely on the use of assistive technology to help them in their day-to-day lives.

Regular Tasks - Day to Day

Dyslexics are not unlike typical people. They still enjoy doing everything that a "normal" person likes to do. Regular tasks for a student in the age range of eight to twelve include going to school and participating in common school activities such as being active during recess and lunch breaks. After school they enjoy playing video games or participating in organized sports. The thought of having to do more school work for them is not something that excites them. Dyslexics often dread having to do homework because it is often such a struggle for them.

Tutoring

Tutoring often plays a large role in dyslexics' ability to succeed in school. The extra tutoring helps dyslexic blossoms in their academic abilities and is often the reason dyslexics are known to be hard workers.

Assistive Technology

A few of the students surveyed mentioned that they use assistive technology, such as Google's Read and Write software, as a way to help them understand what is written or to help get their thoughts out. However, the vast majority of parents and tutors had said that assistive technology was more cumbersome than good, so often these technologies are left unused.

2.1.3 User Observation - Activity Mapping

This activity map will be following the key elements of a traditional tutoring session at a learning center. A tutoring session using the Orton-Gillingham approach is done over the course of an hour - twice per week and is broken down into three different sections of 20 minutes. The sessions are done very rigidly, and are based on repetition and consistency. A full example of a tutors lesson plan can be found in *Appendix L - Other Supportive Raw Data*. In all lessons, the student is facing directly in front of the tutor.

Section 1: Phonogram Review Letter Blending Drill		- Here the tutor uses flashcards with letter combinations on them. This challenges the student to pronounce the different letter sounds out.
Section 2: What Says? S.O.S Sentence Dictation		- Section 2 gives the student the chance to write out what the tutor spoke to them. This can be in the form of a sentence or letter combinations.
Section 3: Oral Reading	1 Hall Bill and a sea of the sea	- The final section is spending some time with the student reading a book of their choice.

Table 2 - User Activity Map

 $Screen shots\ retrieved\ form\ https://www.youtube.com/watch?v=JiZvSvALo-4\ \&\ https://www.youtube.com/watch?v=zZgS8Ij1Ltg$

2.1.4 User Observation - Human Factors of Existing Products

Tutoring sessions for a dyslexic typically only include two positions; standing/walking to the desk and chair, and sitting in the chair at the desk. Current practice and considerations over seating and desk types is minimal as shown in figure 5 below. The figure depicts the lesson being done on a desk designed for a single user with little movement allowed for the chair and student to fit in.



Figure 5 - User Observation

As well, the tutors and students may reach over to the side of the desk to retrieve loosely stored items. These items may not be used in every session, but having close proximity for the tutor or student does not disrupt the flow of the learning.

During a tutoring session, the student uses many smaller products. These include a pencil and paper, flashcards and tactile materials. These will not be redesigned during this thesis as they do not exactly relate to the problem definition.

2.1.5 User Observation - Safety & Health of Existing Products

Health

The general dyslexic products are naturally low for health risks in all of the use cases. However, as these are going to be in an educational setting, such as a school, it is important to understand the products will be touched by many - thus the spread of germs needs to be considered.

Safety

Similarly to the above mentioned health, safety plays an important role in educational products. Current tutoring methods or assistive technologies have no large overbearing safety hazards. The current health and safety of 1:1 tutoring is very low with the only real cause of concern is germ spreading among other children and tutors.

2.2 Product Research

Conducting extensive market and product research is an important step in the understanding of what works and what does not. Looking at the benefits and features of existing products, and the functionality these products affords for the user, allows the designer to do just that. Having gotten a better understanding of the functionality of these current products or methods, the designer is then able to look at the aesthetics and semantic profiles that can help lead the design. What should not be overlooked is the materials and manufacturability of these current products and just how sustainable they are.

2.2.1 Benchmarking - Benefits & Features of Existing Products

Product benchmarking for dyslexia can be a messy process. There are many different products, from teaching children in a playful way, to 1:1 tutoring approaches that target learning to decode words properly. Four select products have been included here, as they allow for a good grasp of a few different solution directions.

Product	Description	Benefits & Features
Scanmarker Pen	Scanmarker is a pen-like tool that allows the user to scan lines of text and upload it to a word document. It also reads the text out loud.	 Reads the text from a physical book aloud Can upload the text to a word doc that can be edited Gets child used to holding a pencil-like-object
Duolingo ABC Phone App	The phone app Duolingo ABC is an app designed in part with language experts to help teach young children the English language in a fun story telling way. It also allows for the children to learn how to write letters.	 Use anywhere, anytime Interactive stories Traceable letters Lessons are designed to feel like a game
Microsoft Flow Space	Microsoft's Flow Space is a work pod that allows the user to focus on the task at hand.	 Gives the user the ability to work in a private setting while in an open concept area Soft and consistent form language throughout Accommodates two main user working postures Preserves some connection to the environment
Square Panda Square Panda Square Panda Retrieved from: https://www.amazon.ca/Square-Panda-Multi sensory-Phonics-Learning/dp/B07K7JPQBF ?th=1	Square Panda is a multisensory, tactile approach to learning phonics with an iPad.	 Playset blends physical and digital worlds Evidence based age appropriate games Parents can keep track of their learning process and see what needs more attention where

Table 3 - Benchmarked Products

2.2.2 Benchmarking - Functionality of Existing Products

Unlike the set up and functionality of a tutoring session as mentioned in section 2.1.4 User Observation - Human Factors of Existing Products, many of the benchmarked products from the above table are for supporting the dyslexic student on their own - not through a learning center. Again, these products really only help to assist the student, rather than really dive into the root cause of dyslexia and have proper tutoring for it.

The products mentioned above are useful in a pinch, or as a fun side game (with the exception of the work pod). They are able to be used just about everywhere and provide an engaging way to experience reading. However, they do not do enough to support and provide top level learning that the 1:1 tutoring does via afterschool learning centers.

A better solution would be focusing on the tutoring environment and making that as accessible to as many different dyslexic students as possible. As the information gathered from students, parents and tutors all suggest that these assistive technologies are just that, assistive, and do not actively support a student the way 1:1 tutoring does.

2.2.3 Benchmarking - Aesthetics & Semantic Profile of Existing Products

An additional part of the benchmarking process was to look for trends in product aesthetics. In the products shown and researched about in *Table 3*, colour stood out as a common factor. Of course products need to be designed for the intended user demographic, and younger children tend to lean towards the feelings that colour gives them. In particular, the varieties of colours used in Square Panda and the Duolingo ABC application really provide a sense of play and engagement for the children.

For 1:1 tutoring environments or office work pods, there are often a lot of muted tones as shown in *Figure 6* on the next page. The ROOM Focus product is a work pod that allows office workers to step into for a private phone call or virtual meeting. While this product was not included in the benchmarking with the others, it is similar to the Microsoft Flow Space, however ROOM is lacking colours. As well, ROOM is very rectilinear. This hard approach is not as welcoming to young students where soft lines and materials are more inviting - especially to a tutoring area that the students actually want to use.

To further this investigation of work pod aesthetics *Figure 7* shows a handful of other common office work pods in the market. While these are not designed specifically for young students, it is clear that a vibrant pop of colour for simulation is not something they try and promote. As previously mentioned, the work pods are almost all square in shape. This could be because it is easy to ship and pack them, but it does provide for a more solid and still form, which an eight or twelve year old may not find as inspiring to work inside.

Improving Dyslexic Children's Learning Experience



Figure 6 - ROOM Focus Room work pod. Retrieved from: https://ca.room.com/



Figure 7 - Aesthetic x, y graph

2.2.4 Benchmarking - Materials & Manufacturing of Existing Products

Current examples of dyslexic assistive technologies and private learning spaces are often constructed out of different types of plastics. For school related seating, many of them are injection molded. While plywood is a natural material - and one that is becoming more commonplace in the school

Colour

environment - fabricators are able to finish the plywood in a nitrocellulose lacquer. The lacquer provides a protective coating and adds to the finished product. It also allows for the school administrative team to easily wipe the product with a common cleaning agent, such as lysol or a 1:10 ratio of water and bleach (K. Belcourt, personal communication, January 20, 2023). This especially applies to the touch screens children share that are commonplace in schools these days.

2.2.5 Benchmarking - Sustainability of Existing Products

As shown in *Table 3* earlier, existing products for dyslexics can widely range. This has a direct impact on the sustainability of them. For example, the use of Duolingo's ABC application requires much less physical materials than Microsoft's Flow Space. Alternatively, the Scanmaker pen is made of plastic with a battery. While it is small in size, it should ideally have an afterlife program to keep it having a low carbon neutrality.

Becoming more common is the take back programs for school furniture. There are also initiatives that exist within school boards that look at making schools more sustainable with higher quality products and recycling programs within schools.

TerraCycle has a program that allows for students to fundraise money by shipping their recyclable products to TerraCycle. With every shipment, the students receive money that they can use towards whatever they are fundraising for (TerraCycle, n.d.).

As well, in 2006, VIRCO, an American company, created the first of its kind recycling program for school desks and chairs, "Take - Back". The program is designed to pick up used and unwanted school products (such as desks and chairs) that would otherwise go into the landfill. From there, the materials are reintroduced into new product streams. VIRCO calls it the first of its kind in the educational industry (VIRCO, 2014).

BCorp is perhaps the most well known program that was founded to create an inclusive and sustainable workplace socially and environmentally. Many companies that wish to be larger than just creating a profit, partner with BCorp to promote social and environmental initiatives. Copernicus Education Products is one local company that has partnered with BCorp.

Understanding these initiatives allows for further conceptualization into what the final design could be. Perhaps it is the use of materials from these take back programs, and or the product is developed with the BCorp ideology in mind.

2.3 Summary of Chapter 2

The objective of this chapter was to look at the user and really get a thorough understanding of their needs. By creating a persona, looking at existing functionality of current methods and practices, the designer is able to use this knowledge to expand off of and refer back to through the design concept

process. Where this is really obvious is when looking at the current tutoring environment, and how the human factors were not thought through with the desk and chairs.

Benchmarking other products on the market made it clear that many of them do not help the student learn to read, but rather are a tool which assists them. In the long run of the students life, this does not provide meaningful benefits that 1:1 tutoring would. Unfortunately, these tutoring sessions are not available to all students, and it marginalizes people who may not be able to access these specific learning centers for various reasons. Work pods, as a benchmarked product are interesting because they could allow for remote tutoring. However, these pods are often drab in colour, and do not provide a warm engaging welcome for the young students to want to use. Regardless, the product needs to keep in mind the use of recycled materials or have carbon neutrality characteristics.

CHAPTER 3 - Analysis

Introduction

This chapter will look at and analyze the primary needs of the user which will lead into, and inform the design. These needs identification will be conducted by means of a user observation at a learning center, ergonomic studies, and by creating design parameters to guide through the design process. Needs statements, categorization of needs and analysis of usability and human factors will be written about. The aesthetics and semantic profile of trends and technologies will be included with key observations into innovation opportunities, should these be feasible and desirable. The objective is to better understand and improve the learning experience for the dyslexic youth.

3.1 Analysis - Needs

3.1.1 Needs/Benefits Not Met by Current Products

As previously mentioned in *Chapter 2* with benchmarking, many of the current dyslexia related products on the market do not do enough to teach the dyslexic, rather it just *assists* them. To truly teach a dyslexic to rewire their brain requires hours of tutoring with a trained professional using an evidence based learning program - such that of the Orton-Gillingham approach. However, understanding this, there are long waitlists for such learning programs because there simply are not enough trained tutors and physical space to teach. The children's schools also do not do enough to support the dyslexic child while they are at school. This is a strong area that needs to improve - providing top level support to these students within the schools where there are currently no such products or programs on the market to do just that.

Ultimately, the assistive products do not help a dyslexic's most basic requirement or challenge - to learn to read properly, and to develop strategies that will stay with them for the remainder of their life. This comes from the special 1:1 education that they receive. *Table 4* describes the needs of the dyslexic student and the potential benefits of addressing the needs.

Needs	Benefits
 Child Learns how to Read Bring High Level Tutoring directly to the Students 	 Builds confidence Allows for every child to have access to tutoring Creates a setting that the child wants to learn in
3. Provide an Engaging Environment	

Table 4 - Needs and Benefits

3.1.2 Latent Needs

Latent needs are the needs that the user does not directly know they need. They are not as prominent as immediate needs, but still play a large role in the overall experience for the user. To assist in this exploration, Maslow's Hierarchy of Needs diagram was referenced.



Figure 8 - Maslow's Hierarchy of Needs

For this particular problem, the latent needs identified based on the user include:

- Ability to continue on with their life feeling capable
- Feel a sense that they are equal with their peers
- Provide a fun environment to learn in

3.1.3 Categorization of Needs

Based on the previous information, the following categorization of needs table was created to identify the majour struggles a dyslexic faces and how pressing each challenge is.

Immediate Needs	Latent Needs	Wants / Wishes
 Learn how to read Bring high level tutoring to students Comfortable 	 Ability to continue on with their life feeling capable Feel a sense that they are equal with their peers Provide a fun environment to learn in 	 Aesthetic for school environment Easy learning curve To enjoy the learning

Table 5 - Categorization of Needs

Categorizing the needs of the user provides a guiding beacon to come back to that can assist the problem definition in informing the design.

3.2 Analysis - Usability

3.2.1 Journey Mapping

The following journey map was created as a way to understand a dyslexics journey over the course of \sim 8 years. This gave the ability to truly understand the problem and see where the large pain points are; first being diagnosed with dyslexia and then waiting to get into a learning center. The point of delight or achievement happens once the student graduates from the program and feels confident in their ability to read and write.

		Pre Diagnosis			After Diagnoses / Pre Learning Center Support			After Learning Center Support		
User Goals	The prever goal are diagness is a attento read at a normal level.	The present gain pre-dispersion is the for the short to save to read. Setting for styring a lappene area the short or tables to read as increase well.			drive dispressed the grant for the child is to find good support resource the Children them want to must.			Goal is to be necessful it reading as a coal enough loss for short to go on it the		
User Action	Speech is delayed or unable to promounce spine exercit contectly.	drugging to understand letters	Nationality function	Ranampi look for support programs	Put on waiting list for afforcation programs	Geft property of when do it in the interim while they wait	Learns for its read property	discussion parts are serving person	Becomes successful in schalauer they do	
User Thoughts	May work dar wity some works are fairber to speec that others, denerally the parents about nation this.	Way wonder why that is, denarchy the periodic work? notice this	May their that ather tells are stronger that they are. Anexes shaud varies (Chey're ship or'r easting well.	Technologi schat ting teaming center wit ter the?	launder hoer ongelt de under eeurogike	that gerings in the neurrinne that's help nat	powers and and a second second second	7 Made 101 sant believe l'isomet al (Mat	Tope do anything Liter my mind last?	
User Feelings	Durth, Han, My	Confused, mentally limit from hying April	Wenally the and frumame.	Ingelant and Protostal relation that they care diagnosed	Arrayad its saving so long	Arrepat, impaction, articlear	Strong conference has	Fran, solvered, and set	Ernut, confident, challenge actapting	
Storyboard			-	-A-			J.	a An		

Figure 9 - Journey Map

3.2.2 User Experience

Figure 10 - User Experience Map

In addition to the journey map, a user experience map was created in order to get a better understanding of how the student feels during their road from diagnosis to graduation. As Figure 14 displays, the user is not in a good place during the time of diagnosis and has to wait for a learning center once they understand that they are dyslexic. The target area to improve upon is reducing the amount of time the user has to wait for a learning center.

3.3 Analysis - Human Factors

Once a child is admitted to a learning center, it is almost certain that they will be seated at a desk. This means that the ergonomics of the desk and chair need to be well suited to an eight and twelve year old.

Methodology

Objectives

Without having a solid and proper ergonomic base to design off of will become problematic later in the design process. This section goes over the methods used to obtain and evaluate the full-bodied human interaction as mentioned in the thesis terminologies (Chong, C., Kappen, D., Thomson, B., Burke, P. & White, K., 2022).

Decisions to be Made

The proper interactions of a tutoring pod are important to get right to allow for a distraction and uncomfortable free learning experience for the student. The majour touch points to investigate are:

- 1. Sitting and getting in and out of chair (legs and arms)
- 2. Having a correct desk height for conducting session (legs, shoulders and torso)
- 3. Correct sightline (torso, neck and eyes)

Description of Users Targeted by Product

The primary targeted users are eight and twelve year olds male or females, as this is often the age when dyslexia is diagnosed. These individuals and their families can live further away from out of school learning centers - resulting in long commutes for support. Their parents annual income is ~\$80,000.

Evaluation Process

The evaluation process was focused on the 1:1 ergonomic mock-up and the 1:1 scale cut outs of the eight and twelve year old. As well, a look at what a 95th percentile would look like when standing next to the pod, gives a different, but useful impression of how a school administrator (possible secondary user) might appear. This provided the crucial in person understanding of scale and proportion for the areas of:

- How the user looks when standing next to the pod
- How the user looks when sitting in the chair
- How the user looks inside the pod facing the desk
- Identifying what a secondary user (school administrator) might be like when standing next to the pod

Description of User Observation Environment Used in this Study

The exercise was observing the 1:1 scale cutouts in situ with the tutoring pod. This was conducted in the Humber workshop.

Location and Timeframe

Date of Observations:	November 30th, 2022
	December 3rd, 2022

Location of Observations: Humber College

3.3.1 Product Schematic - Configuration Diagram

SECTION VIEW

Harry Cotaras

Figure 11 - Configuration Diagrams

3.3.2 Ergonomic - 1:1 Human Scale Study

Improving Dyslexic Children's Learning Experience

Figure 12 - 1:1 Human Factors

Usability

As evident in the images above, the usability of the current pod ergonomics is too large for the target age group. While the table and chair heights are correct, the overall width and height of the pod are too large - resulting in poor reachability and the child feeling small. The distance the screen is from the students eyes is 20" which is in the zone of the correct distances for a child between the ages of eight and twelve (Versant Health, 2016).

Learnability

The ability for the user to learn how to use the product in its physical form is very easy - as it is much like any other desk and chair. The ability to learn should primarily be based on how well the user interface is designed - which will be explored later.

Limitations

The majour three body parts that have an effect on the overall dimensions and details of the product include:

- 1. The seat height and depth the eight year old is not able to put their feet down.
- 2. The distance the screen is to the user for eye strain.
3. How high and wide the desk is - reachability during a tutoring session varies from eight to twelve years old.

Some Ergonomic Issues That Are Still Not Yet Resolved

The user's ergonomic needs that have not yet been resolved include different positions of tutoring including standing up and working at the desk, however this practice is not as commonplace in a tutoring session (observation October 13th, 2022).

Traditional working pods that you may see in an office space have a door to enter and exit out of. While the tutoring pod is not designed for that, further consideration to how a real person enters and exits the pod would provide stronger feedback as to the scale of the product.

Another issue that was only based on the readings of Alvin Tilley and Henry Dreyfuss is that the widest width of a twelve year old is 11". Because the figures are cut out models, there was no way to determine if this was in fact accurate. Understanding this, the seat is 14" wide.

Alternate Possibilities for the Future

Some possible new areas to explore are the sound and lighting of the pod. The "ergonomics" of sound and light play a key role in the user's experience. The exploration of possibly making the pod smaller in diameter is something to consider after seeing the current dimensions. As well, exploring different sizes and dimensions of chairs and how the chair "hugs" the user with more precise ergonomics. Finally, getting a properly aged child to test the scale of everything would provide even more solid feedback and proof to adjust the ergonomics.

Improving Dyslexic Children's Learning Experience

3.4 Analysis - Aesthetics & Semantic Profile



Figure 13 - Mood Board

Symbolism / Aesthetics / Form Giving

Inspiration of the proposed tutoring pod includes some form centered around nature. The barrel of a wave the surfer is surfing in has a beautiful shape that lends itself well to a possible circular form of a pod. As well, the repetitive nature of the artichoke with its repetitive form is an inspiration for texture and reputation in a form giving way. The soft shapes of beach rocks and of muted primary colours adds a level approachability that the traditional office work pods lack.

Semantics

Technology advancements in screens recognizing objects placed on top and merging the digital and physical environments is becoming a large trend in the design and technology sectors. Artificial Intelligence (AI), as a technology option is promising because as previously mentioned, there are not a lot of trained tutors. Utilizing this technology would be able to assist this problem.

Having AI lends itself well to creating a mascot that can represent and provide a visual for the AI. Taking inspiration from this mascot or character that represents the AI should also be married with the physical form to create a more cohesive experience for the student.

3.5 Analysis - Sustainability: Safety, Health & Environment

Schools are slowly starting to add more natural materials into the classrooms allowing for students to feel more in tune with nature - opposed to using plastic materials. As well, when the opportunity arises, society should promote the use of non plastic materials. This is why plywood and wool upholstery has been chosen for use. With the concept behind the product being to bring high levels of dyslexic support to the students in schools, the design and material selection of the pod should be five years ahead of its time - as this is the current trend of North American schools.

Moreover, there is an opportunity for a business model that "loans" the product to schools and returns them when they have finished its use. This prevents it from lying dormant in schools and learning centers when it could be of beneficial use somewhere else.

3.6 Analysis - Innovation Opportunity

An opportunity to advance and disrupt this area of learning support is there. The basis is on bringing high level education to the students through means of AI and private learning pods. Which, from the research is shown to not currently exist.

3.6.1 Needs Analysis Diagram

The following table was created to better understand the user needs. Referencing Maslow's Hierarchy of Needs again, it displays the level of importance for such needs.

Needs	Benefits and Underlying Needs	Level of importance		
Basic Needs Physiological				
Shelter	Sheltered area away from others			High
Comfortable	Interior is comfortable enough to work in for long			High
Safety Safety, securing resources				
Security	Secure away from others			High
Personal goods Safe	Pods are lockable for when you're not in them		Moderate	
Control over environment	Able to work in the pod how you like to work		Moderate	
Social Belonging Effort / resources to belong to a 'tribe'				
Feeling like you belong at work	Being able to feel normal compared to others			High
Fear of competition with other students	Anxiety over comparison		Moderate	
Table 6 - Needs Analysis				

Esteem Personal influence in 'tribe'			
Confidence in yourself	Feeling good about your abilities		High
Respect of others	Feeling like you belong		High
Being able to achieve things	Producing quality work		High
Self-Actualization 'Higher order' Functions/Needs Needs that are predominantly 'outer cortex'			
Emotional	Empathetic to yourself	Moderate	
Creativity	Important to be able to feel like you can be creative in your own way	Moderate	
Problem Solving	Having the right space to	Moderate	

Table 6 - Needs Analysis

3.6.2 Desirability, Feasibility & Viability



Figure 14 - Desirability, Feasibility & Viability Diagram

3.7 Summary of Chapter 3 - Defining Design Brief

A specialized dyslexic tutoring pod for students to learn in while at school, is something that would be new to the marketplace. Current solutions of having to wait to be admitted into a learning center or not desirable for the student nor the parents. Based on the analysis from this chapter a design brief was created:

- 1. Improved accessibility for dyslexia support
- 2. Improved ergonomics for students
- 3. Physically and emotionally a save space for children
- 4. Aesthetically pleasing for student and school environment
- 5. Technology that will be relevant in 5-10 years time
- 6. Engaging for the student
- 7. Low learning curve
- 8. Quality sustainable materials
- 9. Easy assembly for secondary and tertiary users
- 10. Eliminate the need for assistive technology later in life

CHAPTER 4 - Design Development

Introduction

Chapter 4 - Design Development takes a look at the process from initial idea generation to final concept. In between the initial idea generation to the final design resolution includes looking further at concept exploration, with product schematics, and design details. Before diving into the CAD development and the model making process, the finalized design will also be shown. All of which is intended to support the design and be based on the research conducted in earlier chapters.

4.1 Initial Idea Generation

4.1.1 Aesthetic Approach & Semantic Profile



Figure 13 - Mood Board

The aesthetic approach to the tutoring pod with the digital interactions is being drawn from many different natural sources. These inspirational sources provide an ability to create something that is recognizable and soft in nature, providing a more inviting space for the children to learn in. A muted colour palette gives colour without it being too in the face of the child. Balancing these natural trends and hues is the advancement of digital technology through Artificial Intelligence and touch screens.



Figure 15 - STEEPV Matrix Step 2

The process of going through the Social, Technological, Economic, Environmental, and Political analysis (STEEPV) to better understand the trends and needs was important to pinpoint what exactly dyslexic students' needs are. In the top half of the quadrant in the above image was important to draw inspiration from, as these would have higher impacts on the students.



4.1.2 Mind Mapping



4.1.3 Ideation Sketches



This interactive toy was thought to be used as a way to encourage children to learn to read in a fun and unique way. By having the toy go through and teach the students how to read, they are able to have a

lesson anywhere they are. This allows for playful and informal learning in any environment. As well, having the toy be the tutor mitigates the need for an actual tutor who is trained to help dyslexics - whom the demand for heavily outweighs the need.



Figure 18 - Ideation 2

This AR/VR idea was meant to look forward to the possible future of being in a different reality. It would also give the kids the ability to learn from almost anywhere and provide a multi-sensory experience that is known to be important when teaching dyslexics.



Figure 19 - Ideation 3

Having done some onsite tutoring research, getting the visual of the environments that the students learn in, it was obvious that they are not very inspiring or conducive to playfulness. This idea was looking at changing this and seeing just how the environment can be more accessible and exciting.



Figure 20 - Ideation 4

The fourth ideation was looking at the home environment and how larger interactive play can help a child learn. Inspiration was drawn from the kitchen sets that parents can purchase for the child - allowing for a more full and multisensory experience to learning how to read.



Figure 21 - Ideation 5

Dyslexic children often have poor handwriting. This paired with the struggle to pronounce phonics properly leads to frustration. The goal with this idea was to put a digital pencil in the child's hand and let that be the guiding object to help the child learn to read - using it as a pointing object and as a tool to write with.



The sixth idea was to look at a different, but also multisensory approach. Linking the digital and physical worlds by having the tactile letters and a digital display to lean them against. The digital display is there to help guide and teach the child about the letters and the different sounds they make.

4.2 Concepts Exploration

4.2.1 Concept One - Interactive Play

The first concept direction is looking at combining the digital and physical worlds with interactive play. As learned throughout the research phase, dyslexics do well when they are being taught in a multisensory way. By combining the use of AR with tactile products the child is able to better learn with the digital aspect of some sort of glasses and with physical products. A few different environments of use were also thought of, this includes the home, school and learning areas.



Figure 23 - Interactive Play Concept 1



Figure 24 - Interactive Play Concept 2



Figure 25 - Interactive Play Concept 3

4.2.2 Concept Two - Penmanship

Concept two was focusing on the penmanship of the child. How can an environment be more creative and inducing for the child? Utilizing digital and physical spaces gives a more multisensory experience and provides for a unique opportunity for the child to be creative with how they choose to learn. Just like one of the ideas for this concept was being able to use any found object as a writing utensil.



Figure 27 - Penmanship Concept 2

4.2.3 Concept Three - Tutoring Environment

The tutoring environment concept is specifically targeting the environment in which the child learns. Because many tutoring places are outside of schools and these resources lack trained tutors, one of the ideas for the concept was to bring the tutoring to the schools in the form of a tutoring pod that allows for trained tutors to remotely work. The pods would be placed in schools allowing for more accessibility for the children. As well, another idea was looking at redesigning the current tutoring environment at these resources centers. Many of the furniture is donated, but does not serve the best ergonomically for the children.



CONCEPT 3 HARRY COTARAS

Figure 28 - Tutoring Environment Concept 3



Figure 29 - Tutoring Environment Concept 3

4.3 Concept Strategy

4.3.1 Concept Direction & Product Schematic One

The first concept with product schematic included is focused on a formal tutoring environment. Creating an engaging space for the children to learn in and that is accessible for as many children as there needs to be by bringing the tutoring pods to the schools and having the tutors teach remotely. This idea required further explanation with the use of product schematics and preliminary ergonomic dimensioning. As well as featuring the dimensions of the user groups and product, the diagram roughly shows the size and position of different components that the pod needs. Improving Dyslexic Children's Learning Experience



Figure 31 - Concept Strategy 1 - Tutoring Pod



Figure 33 - Concept Strategy 1 Schematic - Tutoring Pod

4.3.2 Concept Direction & Product Schematic Two

The second concept direction was also looking at the tutoring environment, but rather than more formal tutoring, it is self taught informally at home. The idea was inspired by children enjoying building forts and playing in them. Again, this is taking on the idea that dyslexic children like to be more multisensory and playful. Understanding this, the need to know dimensions and the components of just how the product would function is crucial. The preliminary dimensions of the fort are important to understand the scale and proportion of different components within the space of the user's house.



Figure 34 - Concept Strategy 2 - Self Learning



Figure 35 - Concept Strategy 2 - Self Learning



Figure 36 - Concept Strategy 2 - Self Learning

4.4 Concept Refinement & Validation

Progression of the more formal tutoring pod was chosen because it would truly allow for a stronger learning experience. Having tutoring pods around different schools allows for more students with dyslexia to be reached and supported. Solely relying on out of school support puts families without a car at a disadvantage and because there are not many learning centers, they are often heavily waitlisted. Bringing these formal tutoring pods to the schools and having trained tutors work remotely will provide stronger tutoring for students when compared to the self directed fort like in another concept. These pods will provide stronger support for the students learning to read better.

4.4.1 Design Refinement



Figure 37 - Tutoring Pod Design Refinement



Figure 39 - Tutoring Pod Design Refinement

4.4.2 Detail Development



Figure 40 - Tutoring Pod Design Refinement



Figure 41 - Tutoring Pod Design Refinement





Figure 42 - Tutoring Pod Design Schematic



TOP



FRONT





SECTION VIEW

4.5 Concept Realization

The following sub-chapter will look at the design finalization with refined configuration diagrams, and sketches. It furthers the design from the previous section. As well, a ¹/₄ scale physical model was built to further iron out details and confirm the appropriate scale for the final model.

4.5.1 Design Finalization

Based on previous product schematics, sketches, mood boards and human factors - the following revised sketches and product schematics were created. The overall form is private enough for a student to learn in, while not feeling claustrophobic. The chair, while not physically height adjustable, is able to accommodate a wide range of children sizes with its creative straddle shape.



Figure 43 - Design Finalization Schematic

















Figure 45 - Pod Design Refinement Sketches

This "finalization" was not the end all be all. There were smaller details that changed even from this stage in the process. As shown in *Figure 44*, the straddle version of the chair went through a few different iterations for it to finally make sense and appear to complement its design language with the pod. For example, an early iteration of the chair featured two humps that were injection molded plastic and sleigh-like legs made of steel tube. However, this quickly contrasted with the beautiful form the pod was offering with the use of wood. Further work was done to allow the chair and pod to look like family.

4.5.2 Physical Study Models

Utilizing the above sketches and product schematic, the following ¹/₄ scale model was built. Going through this exercise provided confirmation that the product schematic dimensions were correct and helped set the scene for the final scale model. One realization after conducting this study was the need to open the pod up more so the chair was able to fit in better with the student at the desk. Another realization example is the change in desk shape. Here, the desk is more equal on both sides, where there is the opportunity to create a more unique asymmetrical desk.



Figure 46 - 1/4 Scale Sketch Model





This stage was crucial to really look at the dimensions in a scaled fashion and proved evidence that the design is feasible. It allowed for the concept to be realized and provided insights into what needed to change prior to starting CAD. Throughout the model development, different forms of the chair took place that improved upon and furthered the sketches done in section *4.5.1 Design Finalization*.

4.6 Design Resolution

The design resolution includes an open, but private pod made of ³/₄" plywood with 100% wool acoustic panels interior. This is where the child will be able to focus on the lesson at hand. It features two

screens. One vertical non touch screen is paired with a touch screen desk where the child will interact with. The accompanying chair is made of similar materials, with the wool doubling as the felt for the child to sit on. The chair's form also allows the child to be creative and explorative with how they would like to sit. Providing a "straddle" like position with the leg rockers allows the child to fidget by rocking side to side. As well, understanding that dyslexic children learn in a multisensory way, a haptic motor was added underneath to provide lesson feedback. The aesthetics of the duo are inspired by nature and the "flow" of children's young lives.



Figure 47 - Final Design





The touch screen desk interactions are based on the preexisting, and proven, Orton-Gillingham method for dyslexics. It mimics - in a digital fashion - how a usual session will go. Artificial intelligence was chosen to lead the lessons as this is the direction the world is going thinking five years ahead of time.

The way the AI is being presented was an opportunity that could be taken advantage of. The following characters; Elliot the Elephant, Peter the Polar Bear and Larry the Lion, were created to guide the children through their lessons in a fun and engaging way.





4.7 CAD Development

The CAD development was done entirely in Solidworks over the duration of a month. Throughout the process, the design of the chair changed slightly from the ¹/₄ scale sketch model - this is in part due to the limitations within CAD. While the overall shape and functions stayed the same, it was the slight change in dimensions that drove the subtle appearance differences. Both solid bodies and surfaces were used to create the forms (CAD images grouped by chair and pod separately in figure count).

Chair




Pod



Figure 51 - Pod CAD Development



4.8 Physical Model Fabrication

The physical model was primarily 3D printed at Agile Manufacturing, with the exception that the chair saddle was printed at Humber using Tony's resin printer. Additionally, the screws and nuts that connect the chairs' rockers to the body were purchased from a local hobby shop (model images grouped by chair and pod separately in figure count).

Chair

The chair body, horizontal rockers and electronic housing was 3D printed in SLA. All of these parts were sanded and primed before giving them a base wood colour spray paint. The seat saddle, as previously mentioned, was printed on Tony's resin printer. Upon printing, the saddle was covered in a 100% wool material to mimic what it would be like in real life. To achieve the faux wood like appearance, paint brushes with unique strokes were done.



Figure 52 - Chair Model Making





Pod

The pod, desk and screen were 3D printed in SLA. The same process of sanding, priming and spray painting a base wood colour was done such as what was done on the chair. The same wool material that was used for the seat was also used as the internal wool acoustics. The screen images were a printable sticker back.



Figure 53 - Pod Model Making

Summary of Chapter 4

This chapter looked at the complete design development from initial ideas through to the development process, CAD work, and into a physical ¹/₄ scale model.

CHAPTER 5 - Final Design

Introduction

Chapter 5 will look at the final design for the titled project "ReCess" - a play on words for Reading Success. Speaking on its full bodied interaction, materials, and design implementation - bill of materials (BOM). Final renderings of the product, with images of the final model and technical drawings will be included. Finally, the sustainability of the project will be touched upon.

5.1 Design Summary

The final design for ReCess is a plywood pod with accompanying chair and on screen user interface. The pod is where the learning will take place with the chair providing haptic feedback throughout the lessons for a stronger learning experience. ReCess is to be set in schools allowing for dyslexic children to easily access it.

School boards aren't doing enough to support the young dyslexic forcing their families to look outside of school for help. Additionally, there are few learning centers around Canada that offer this kind of support - putting many young children at risk for struggling with their literacy. Those that are fortunate are met with uninspiring learning centers that feel institutionalized. Often the furniture is donated, and the buildings where these learning centers reside are retrofitted and built private 1:1 rooms.

ReCess tackles this problem by bringing the advanced learning that a child receives in a learning center directly to the schools. It provides a more engaging environment and multisensory learning experience that dyslexics need. It benefits the young dyslexic, their family, and ultimately society as a whole for improving children's right to read.

5.2 Design Criteria Met

The design criteria to meet and satisfy the thesis requirements include the enhancement of human lifestyle, human interaction, ergonomics and sustainability & social responsibility. The following section will look at the full bodied human interaction, materials, processes and technology and design implementation BOM.

5.2.1 Full Bodied Interaction Design



Figure 54 - Final Product Schematic

5.2.2 Materials, Processes & Technology

This subsection will explore and dive deeper into the different materials, process and technology that contributes to ReCess.

Materials

As previously mentioned, the materials that make up ReCess Primarily include ³/₄" plywood, 100% wool felt and recycled stainless steel. Stainless steel is easily recycled and provides a strong foundation for the side to side rockers on the chair.

Starting to trend more in North American educational facilities is the use of natural materials, such as wood. Wood, an increasingly common material in educational products, is becoming more important as we start to realize how much time children are indoors learning - and what materials we want them to be interacting with. While this is nothing new for educational facilities around Europe - North American schools, and learning centers, are slow to make the transition (K. Belcourt, personal communication, January 20, 2023).

While upholstery does give a more welcoming and approachable feel - that is important in an educational setting, the material of the fabric is usually a synthetic blend. Ultimately synthetic products are a type of plastic which is derived from the oil industry. While there is the ability to create synthetic materials from recycled products instead of virgin material, this still requires a lot of energy and effort. Understanding these to be a downside of synthetic products, they are however resilient to wear and tear at a low financial cost - this is also what makes them strong contenders for use in commercial settings.

Wool is a natural alternative to synthetic materials. It provides the same sense of approachability while also being sustainably sourced from sheep. It too has durable properties with resistance to wear and tear, and is also antibacterial and antimicrobial (Skein, 2015).

Wool felt is known to be resistant to the everyday wear and tear that commercial furniture goes through. As well, wool also has anti-microbial properties that make it mold resistant - another great property to have in school locations (White, 2021). Similarly to the benefits to wood in educational settings, wool adds to this natural material that children will contact and interact with. It is also sound absorbing, making it ideal to line the interior of the pod. Additionally, the colour green for the wool is important as it symbolizes "growth" and "optimism" and can provide a sense of calmness to the student.

Understanding the touch and contact that children will have with the materials, this brings up the question on bacteria and germs. According to Kaylyn Belcourt at Copernicus Educational Products, in the manufacturing process, fabricators are able to finish the plywood in a nitrocellulose lacquer. The lacquer provides a protective coating and adds to the finished product. It also allows for the school administrative team to easily wipe the product with a common cleaning agent, such as lysol or a 1:10 ratio of water and

bleach (K. Belcourt, personal communication, January 20, 2023). This especially applies to the touch screen desk that the children will use to interact and go through a lesson.

Manufacturing Process

The manufacturing process for ReCess is centered around steamed wood. Steaming is of course a natural process for softening materials. Similar to the material choices, this method of forming wood allows for a natural way that adds a "soft" look to the products. Forming the chair in a jig with steam being sent through the jig allows for the plywood to be contoured to the exact shape in a large mass manufacturing scale. The panels that make up the pod are individually formed with steam, but feature cutlines that provide an aesthetic appearance to the pod's outer shell.

The wool seat cover for the chair is also able to be formed in this steaming manner with a jig. Manufacturing wool in this method provides for no seam lines and is commonplace in wool products such as slippers and hats.

Technology

ReCess features artificial intelligence technology that mimics a real tutor for the children to learn from. The screens in which the child touches and views are LCD displays. The vertical screen has a custom screen that curves following the form of the pod. This AI technology allows for each child to have their own animal character to choose - guiding them throughout their learning journey. Having this technology also means that trained tutors do not need to drive all around, saving time and fuel.

5.2.3 Design Implementation

Chair



Item #	Description	Quantity	Material	Manufacturing Method	Price
1	Electrical Housing	1	Polypropylene	Injection Mold	\$10.00
2	Body	1	³ / ₄ " Birch Plywood	Steaming	\$75.00
3	Rocker	2	Recycled Stainless Steel	Break and form and roll	\$15.00
4	Seat Saddle	1	100% Wool Felt from KVADRAT	Steaming	\$80.00
5	18-8 Stainless Steel Torx Flat Head Screw	8	Stainless Steel	/	\$8.00
6	18-8 Stainless Steel Hex Nut	8	Stainless Steel	/	\$8.00
7	18-8 Stainless Steel Washer	16	Stainless Steel	/	\$4.00

Table 7 - Chair BOM





Figure 56 - Pod BOM

Item #	Description	Quantity	Material	Manufacturing Method	Price
1	Panel 1	1	³ / ₄ " Birch Plywood	Steaming	\$50.00
2	Panel 2	1	³ / ₄ " Birch Plywood	Steaming	\$50.00
3	Panel 3	1	³ / ₄ " Birch Plywood	Steaming	\$50.00
4	Panel 4	1	³ / ₄ " Birch Plywood	Steaming	\$50.00
5	Panel 5	1	³ / ₄ " Birch Plywood	Steaming	\$50.00
6	Panel 6	1	³ / ₄ " Birch Plywood	Steaming	\$50.00
7	Acoustic Interior	10 yards	100% Wool Felt from KVADRAT	Steaming	\$600.00
8	Desk Screen	1	LCD Display	Per Manufacturer's Specs	\$250.00
9	Vertical Curved SCreen	1	LCD Display	Per Manufacturer's Specs	\$500.00

Table 8 - Pod BOM

5.3 Final CAD Renderings





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Figure 57 - Chair Renders
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Figure 58 - Pod Renders

5.4 Physical Model



Figure 59 - Chair ¼ Scale Model









Figure 60 - Pod ¼ Scale Model





5.5 Technical Drawings

The following drawings give technical dimensions and information on the products for ReCess at a top level assembly.



5.6 Sustainability

ReCess is a sustainable product largely because of the material choices. Wood and wool are naturally sustainable and also have the added benefit of improving the interior space for schools with its natural materials. The manufacturing of these products is also very important to consider. ReCess takes the use of natural materials further, by forming the plywood and wool in a natural method - steaming. The sustainability aspect of having AI characters is also important. Instead of having a real tutor drive to different schools or having the families of the children drive them to the learning centers. This reduces the amount of commuting and time of the road, subsequently reducing the CO2 emissions.

ReCess can also be part of a larger business model in that the products can be on loan from the school boards. School boards would only need to purchase a few and transfer them from one school to another when the need strikes.

Summary of Chapter 5

This chapter was looking at the final design of ReCess. From the materials, human interaction and design implementation. It also provided the final CAD renderings, ¹/₄ scaled model and technical drawings with overall dimensions. The chapter provided the outcome of all the evidence based research that took place in earlier chapters.

CHAPTER 6 - Conclusion

ReCess is a dyslexia tutoring pod for schools. One struggle that young dyslexics face is not having enough accessible support from the schools - meaning their families are forced to look outside of school for help. This is problematic because there are not nearly enough learning centers in Canada, let alone in our communities. The user observation research also clearly indicated that the learning centers have a stark and uninspiring environment for the children to learn in. This provided the opportunity to create an engaging and multisensory learning environment.

ReCess uses sustainable materials in a sustainable manufacturing process. It also uses advanced AI characters to reduce the amount of tutors that need training and to reduce the amount of commuting people need to do. It is also focused on the dyslexic students' needs with multisensory learning. ReCess brings the specialized multisensory tutoring of Orton-Gillingham directly to the schools where it is accessible, and impactful, to all dyslexics.



Figure 63 - In-Situ Render

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Appendix A – Discovery

The following includes raw data that initiated the development of the project. It features data from designer notes and general literature.

	OBSERVATIONS. OCT. 8, 2022 B
Ð	
+ HAUE	IMAGES AND LETTER CONSINTERS
OP F	CASH CARDS
+ WHEN	MISTAKES HAPPEN STUDENT
WRIT	ES WITH FINGER ON TARE LETTER
CONBI	E. LOUD STEAKS OUT LOUD 3
+ ASKS	ABOUT VOWEL SOUNDS
> OY	VEW SOUND.
+ USES	MUCTISENSORY
-> THEY	ARE ALSO LEARNING THE UNDERSTANDING
+ USE	OF RHYME GTHE ENGLISH
A POIN	IS WITH FIRM
→ * WA	X WHAT DOES THAT TWIDED IN
CET	TERS " STALABLUS"
+ HANON	ENISM. HONEFALONES. "BY BUY"
+ TUTO	R UARIES THE AMOUNT DIRECTION
TO	WHICH STUDENT RESPONDS (NERBAY WRITTE
+ REPEN JUST	LEADED.
+ thes]	PAD OT KES DRAWTUS, When mistak
+ AR	T. MATH & EASY LIKE
2 Dot	SUT LIKE WRITING SO UP ENGLISH
+ Ex	PERIMENT.
A BROTH	SR ITH NOTSED.
-A TEACH	ME HOW TO READ BETTER.
→ FEQ.I	NG LOOS OF THEMSELVES.
LENEN	BY TOUCHING,
TKES	TO RUN /HIKE BEENS OUTSIDES
ALTIMAC.	- VET - VER TECHO



Step 2: Major Challenges / Issues - Dyslexia in Youth

1. Humber Library Book

Overcoming Dyslexia - A New and Complete Science-Based Program for Reading Problems at Any Level APA Citation

Shaywitz. (2003). Overcoming dyslexia : a new and complete science-based program for reading problems at any level (1st ed.). Knopf.

- The brain is wired incorrectly during embryonic development
- Systemic bias that boys are more likely to have dyslexia than girls
 Boys' more rambunctious behaviour may suggest to the teacher that they need to be evaluated, whereas more well mannered girls go unnoticed, but perhaps are diagnosed later on.
- Seeing letters or words as being written backwards is a linguistic trouble, not visual
 Not being able to read well can result in low levels of confidence, stress/anxiety etc.
- Not being able to read well can result in low levels of confidence, stress/anxiety etc
 3.5% of the American school population between the ages of six to twenty-one are
- 3.5% of the American school population between the ages of six to receiving special educational services

2. Peer Reviewed Online Search: "Dyslexia Treatments"

What can reduce letter migrations in letter position dyslexia?: TREATMENT OF LETTER POSITION DYSLEXIA

APA Citation Friedmann, & Rahamim, E. (2014). What can reduce letter migrations in letter position dyslexia?: TREATMENT OF LETTER POSITION DYSLEXIA. Journal of Research in Reading, 37(3), 297–315. https://doi.org/10.1111/j.1467-9817.2011.01525.x

- Finger tracing is one of the most reliable ways to reduce letter manipulation
 Allows for allocation of attention to each letter rather than grouping all the letters together.
- Spacing between letters (anywhere between 2-6 spaces) brought reading errors down to below baseline.
- None of the participants benefited from colouring each letter. It adds another layer of thinking

Peer Reviewed Online Search: "challenges diagnosing dyslexia" Early Identification of Dyslexia: Understanding the Issues APA Citation

Colenbrander, Ricketts, J., & Breadmore, H. L. (2018). Early Identification of Dyslexia: Understanding the Issues. Language, Speech & Hearing Services in Schools, 49(4), 817–828. https://doi.org/10.1044/2018_LSHSS-DYSLC-18-0007

- Early identification of dyslexia is tough but essential to addressing the problem to help the children down the line.
- Speech language pathologists (SLP) should work alongside teachers to help implement early identification - they have experience with phonological training for kindergarteners.
 For grade 1 and 2 assessments should be of the ability to read simple nonwords and common regular and nonregular words.
- Ongoing cycle of monitoring with multiple different assessments is best. This also allows
- for students to identify their strengths key ways to inform intervention choices.
 Using a tiered approach for all students (Response to Intervention RTI). When students are struggling in the first tier they are dropped down and are monitored in the second tier.
 - If the students are still struggling here, then they may be referred to in-depth assessments or special education to meet their needs. A benefit of this approach is that

the childrens reading is constantly being monitored and it doesn't allow for the "waiting to fail" mentality. Funding is the toughest part of this option.

4. Google Searched: "current treatments for dyslexia"

APA Citation Mayo Clinic

https://www.mayoclinic.org/diseases-conditions/dyslexia/diagnosis-treatment/drc-20353557

- Number of factors are considered for diagnosis
 - Developmental history (anyone in the family with dyslexia)
 - Testing reading and writing abilities
 - Vision or hearing examinations (could be the reason the child is having difficulty reading)
 - Psychological evaluation
 - Educational tests
 - Treatments Should Include
 - Learn to identify small letter combinations and the sounds they make (phonemes & phonics)
 - Comprehension
 - Reading out loud for accuracy and expression
 - Vocabulary of recognized words
 - Parents can read aloud with their child to encourage reading
- Multisensory exploration

5. Executive summary: Right to Read: Ontario Human Rights Commission

- "Ontario does not currently have universal, systematic, evidence-based early screening to identify at-risk students who need additional instruction and immediate interventions. The current approach is inconsistent, ad hoc and relies mostly on non-evidence-based reading assessments. This leads to many at-risk students not being identified and receiving intervention early enough or at all."

- "Age four to seven is a critical window of opportunity for teaching children foundational word-reading skills and is when intervention will be most effective."
- "The Ministry should require boards to screen every student twice a year from Kindergarten Year 1 (formerly known as Junior Kindergarten) to Grade 2 with valid and reliable screening tools, and provide boards with stable, enveloped yearly funding for screening."
- "Many more students will learn to read if we change our current approaches to classroom reading instruction, screen all students and then provide early and tiered evidence-based interventions."

Appendix B – Contextual Research (User)

The following survey results are with current dyslexic children (the primary user). There is also some summarization with different interview speakers and demographic profiles.





We are empathizing with 12 year old dyslexic Duncan who needs to learn how to read and write stronger.

Primary Users

- Dyslexic Students
 aged 8-12
- Classroom
- Teachers
- Tutors

Secondary Users

- PsychologistsSpeech Language
- Resource Teachers

Tertiary Users

- Administrators
- IT Staff

Top 3 Opportunities Impact of new technologies Largest struggles faced? Experience getting observation and anthropology, how does that work for younger children?

Chat with Mary Jane Harkins:

- Ages 5-8 is when phonics comes into play
- Screening enough
- Intervention is the most important part
- Developmental attitudes that they can't
- -

Chat with Kaylyn Belcourt

- They test all their products in class
- She started the IDEA Lab
- Important to start with onboarding / background of company
- Media release form for approval of pictures
- Police Checks
- Do the teachers know that some students are going to after school programs for dyslexia?

Chat with Thelma Gregan:

Is diagnosing an area where we can improve the most?

What tools do they use for diagnosing?

Do you have any quantitative data for me? Are there any parents that would be willing to speak to me about the struggles they've faced?

- Right to Read -> Ontario Government Human right.

Chat with Jill Kearney

- Top 10 for Readings
- Tools4Reading
- Proper Instruction, Proper Handwriting, Quieter places to work
- Informal assessments for pre unofficial diagnosis.

Chat with Cynthia Plant-Hansen

- Top challenge she faces is working with kids who have experienced emotional/cognitive trouble. They're not being there because they want to, but because their parents are making them go.
- She may use YouTube videos to emphasize the importance of a topic
- She's primarily material based (pencil and paper)
 - Research that shows writing makes it easier for students to remember rather than type
- Thinks there should be a repository for technology for dyslexics
- Microsoft Inclusivity
 - Physical handicaps
- Multisensory experience
- She agrees that Kurizwell is cumbersome and not intuitive
 - Maybe there is opportunity for chromebook integration
- Thinks students should understand root words better. We should understand the language that we speak

Appendix C – Field Research (Product)

The following are some images from an in person observation of current practices.



Feature / Benefit

Product #1 Duolingo ABC https://www.duolingo.com/abc



DUOLINGO ABC FEATURES: (from app store)

Lessons & Stories:

- Engage kids in hands-on learning they will love!
- New lessons are added often, so there is always something new to discover!
- Bite-sized lessons help kids learn phonics, sight words & vocabulary
- Enjoy fun activities like letter tracing and interactive stories, suitable for even the youngest learners
- Kids will love, play and learn from Duolingo ABC's cast of characters!

Designed For Kids, By Experts:

- Designed by literacy & early-education experts to develop kids' skills in phonics, sight words, reading & more
- Lessons are built to feel like a game, mixing learning with fun!
- Get children excited to learn with mini games & rewards to stay motivated and keep going
- Thoughtfully designed learning sequences will build confidence in your kids with each success!

Kid-Safe & Ad-Free

- Rest easy, parents: There are no ads or in-app purchases to worry about
- Age appropriate content: content is focused on preschool, kindergarten and first grade level lessons

Offline Learning

- On a plane? At a restaurant? Duolingo ABC can be used anytime, anywhere
- Enjoy playing and learning offline so kids can learn wherever you go

Duolingo ABC is an educational learning app that offers immersive lessons to teach preschool to first grade kids reading fundamentals.

Feature / Benefit

Product #2 C-Pen https://cpen.com/products/examreader/



Enable independent reading

Enable students to become independent readers with the help of ExamReader.

What is ExamReader?

ExamReader is a **convenient portable off-line assistive text reader** for printed text. Scan text with this **state-of-the-art device** and have text read out to you aloud in real time. Everything, including the natural speaking voices, is embedded in this off-line device and there is no **need for computer or internet connections**. ExamReader is specifically designed for use in tests and exams when a student requires reading assistance. No unauthorised material or content can be loaded onto ExamReader and it can *only* be used to support text reading.

Level the playing field

A student who has a hard time reading the questions can hardly be expected to be able to provide proper answers. ExamReader assists the students to read the questions but offers no help with the answers. Using ExamReader with earphones enables these students to be in the same room as their peers when taking the test, saving school resources.

Exciting ExamReader features Read printed text out aloud in multiple languages. No wifi required. An off-line closed system with no opportunity to store any assistive content. Speaker and earphone jack. Rechargeable battery sufficient for a full day use.
31 Natural Text-to-Speech voices in over 18 languages and dialects

Feature / Benefit

Product #3 Kurzweil 3000 https://www.kurzweiledu.com/k3000-firefly/features.html



Customizable reading rate and presentation Improve readability with OpenDyslexic font and Text magnification ABBYY FineReader® OCR-highest accuracy in reading aloud Magnify text for learners with visual impairments Keyboard shortcuts Read text in Word, PDF, EPUB, RTF, Daisy, and on the Web Read locked text in PDFs and images, exactly as they appear Access to over 1,800 classic literature texts Create MP3 files and add to iTunes Playlist Resume Reading brings opens the exact page you were last reading Ensure reading and test-taking integrity-now even faster-with Dual Zone Editing Use Page Range to bring in select pages or chapters into the online library Read aloud basic math with Talking calculator Change background and text color with the click of a button One-click access to American Heritage dictionaries®; Fifth Edition, Children's, and College Writer's Dictionary Widgit Picture Dictionary and Talking dictionary Expand word choices with the Synonym button Vocabulary study guides; English and bi-lingual Engage learners with 5 different Note tools; including Sticky and Voice notes Mark important place in text with Bookmark tools Highlight key text structures with Multiple colored highlighters Cross-out text to aid with the process of elimination Identify important information with red and blue Circle buttons Create Study guides Organize text into Column notes

Feature / Benefit

Product #4

Square Panada

https://www.amazon.ca/stores/Square+Panda/page/B667CC04-144F-4165-A66C-56207771D706?ref_=astbl



Square Panda is a learning system that helps your child learn to read using multisensory play. Designed for kids two and older, the playset blends physical and digital learning as it keeps kids entertained through age-appropriate games grounded in research-based curriculum. Early readers play their way to reading fluency as they engage with physical smart letters that connect them to a library of learning games. Every play session guides children through the game as they explore the alphabet, letter sounds, discover rhymes, build vocabulary and more!

Square Panda helps children ages 2-8 learn to read through fun games grounded in research and uses a multisensory approach, combining sight, touch and sound in each play experience

The system includes a playset, which doubles as a storage tray, 45 smart letters and access to a library of free learning games ******Tablet Not Included******

Access to a customizable Parent Portal database that stores children's words, pictures, milestones and learning progress

Learning games available free to download on the the App Store and Google Play

Research-based curriculum based-upon best practices in how children learn to read

The Square Panda Playground allows parents to keep track of their child's learning progress, giving them visibility into problem areas in need of attention, such as letter orientation, word play and letter confusion.

Big Badge Graphs: View detailed progress mapping for each primary curriculum milestone.

Mini Badges: Just for fun! Your child earns these badges when they spell their name, numbers and even the words "Square" and "Panda!" Customization: Add any word or picture to your child's personalized, private database! Add your child's name, your picture with the word "Mom," your family pet, school mascot or even a picture of your child playing their favorite sport! This database adds an element of personalization and surprise that delights children over and over again!

BENEFITS	GROUP LIKE CATEGORIES
convenient portable off-line assistive text reader	Engage
Enable independent reading	Engage
Engage kids in hands-on learning they will love!	Enable
Engage learners	Enable
Expand word choices	Helps
giving them visibility into problem areas in need of attention, such as letter orientation, word play and letter confusion	Helps
helps your child learn to read using multisensory play.	Reading
Identify important information	Readng
Just for fun!	Learn
Magnify text for learners with visual impairments	Learn
need for computer or internet connections	Learn
Resume Reading brings opens the exact page you were last reading	Learn
so kids can learn wherever you go	Learn
so there is always something new to discover!	Learn
Square Panda helps children ages 2-8 learn to read	Child
that delights children over and over again!	Child
used anytime, anywhere	Child
Using ExamReader with earphones enables these students to be in the same room as their peers when taking the test, saving school resources.	
will build confidence in your kids with each success!	
FEATURES	GROUP LIKE CATEGORIES
31 Natural Text-to-Speech voices in over 18 languages and dialects	Fun
age-appropriate games grounded in research-based curriculum.	Fun
allows parents to keep track of their child's learning progress,	Fun
An off-line closed system with no opportunity to store any assistive content.	Fun
Customizable reading rate and presentation	Read
database adds an element of personalization and surprise	Read
Designed For Kids By Experts	Read
Designed for inter, by impre-	
Everything, including the natural speaking voices, is embedded in this off-line device	Read
Everything, including the natural speaking voices, is embedded in this off-line device fun activities like letter tracing and interactive stories	Read Learn
Everything, including the natural speaking voices, is embedded in this off-line device fun activities like letter tracing and interactive stories fun games grounded in research and uses a multisensory approach, combining sight, touch and sound in each play experience	Read Learn Learn
Everything, including the natural speaking voices, is embedded in this off-line device fun activities like letter tracing and interactive stories fun games grounded in research and uses a multisensory approach, combining sight, touch and sound in each play experience learning system	Read Learn Learn Learn
Everything, including the natural speaking voices, is embedded in this off-line device fun activities like letter tracing and interactive stories fun games grounded in research and uses a multisensory approach, combining sight, touch and sound in each play experience learning system Lessons are built to feel like a game, mixing learning with fun!	Read Learn Learn Learn Learn
Everything, including the natural speaking voices, is embedded in this off-line device fun activities like letter tracing and interactive stories fun games grounded in research and uses a multisensory approach, combining sight, touch and sound in each play experience learning system Lessons are built to feel like a game, mixing learning with fun! Mark important place in text with Bookmark tools	Read Learn Learn Learn Learn Learn
Everything, including the natural speaking voices, is embedded in this off-line device fun activities like letter tracing and interactive stories fun games grounded in research and uses a multisensory approach, combining sight, touch and sound in each play experience learning system Lessons are built to feel like a game, mixing learning with fun! Mark important place in text with Bookmark tools New lessons are added often	Read Learn Learn Learn Learn Learn
Everything, including the natural speaking voices, is embedded in this off-line device fun activities like letter tracing and interactive stories fun games grounded in research and uses a multisensory approach, combining sight, touch and sound in each play experience learning system Lessons are built to feel like a game, mixing learning with fun! Mark important place in text with Bookmark tools New lessons are added often No wifi required.	Read Learn Learn Learn Learn Learn
Everything, including the natural speaking voices, is embedded in this off-line device fun activities like letter tracing and interactive stories fun games grounded in research and uses a multisensory approach, combining sight, touch and sound in each play experience learning system Lessons are built to feel like a game, mixing learning with fun! Mark important place in text with Bookmark tools New lessons are added often No wifi required. offers immersive lessons	Read Learn Learn Learn Learn Learn
Everything, including the natural speaking voices, is embedded in this off-line device fun activities like letter tracing and interactive stories fun games grounded in research and uses a multisensory approach, combining sight, touch and sound in each play experience learning system Lessons are built to feel like a game, mixing learning with fun! Mark important place in text with Bookmark tools New lessons are added often No wifi required. offers immersive lessons Offine Learning	Read Learn Learn Learn Learn Learn
Everything, including the natural speaking voices, is embedded in this off-line device fun activities like letter tracing and interactive stories fun games grounded in research and uses a multisensory approach, combining sight, touch and sound in each play experience learning system Lessons are bulk to feel like a game, mixing learning with fun! Mark important place in text with Bookmark tools New lessons are added often No wifi required. offers immersive lessons Offline Learning One-click access to American Heritage dictionarie@; Fifth Edition, Children's, and College Write's Dictionary	Read Learn Learn Learn Learn

Benefits Table

Key Benefits of Comparable Products		
Keyword	Frequency	
Learn	6	
Engage/Enable	4	
Child	3	

Features Table

Key Benefits of Con	parable Product
Keyword	Frequency
Learn	5
Fun	4
Read	4

Appendix D – Result Analysis



CATEGORIZATION OF NEEDS

IMMEDIATE NEEDS	LATENT NEEDS	WANTS/WISHES
 Ability to get learning to read support Ability to read and write well Better penmanship 	 Better penmanship To read for comprehension Feeling confident 	 To be self sufficient To read for enjoyment To not feel like their different Not feeling like they're behind



Harry Cotaras



Appendix E – CAD Development









Appendix G – Technical Drawings

Appendix H – Bill of Materials Info/Data

CHAIR

Item #	Description	Quantity	Material	Manufacturing Method	Price
1	Electrical Housing	1	Polypropylene	Injection Mold	\$10.00
2	Body	1	³ ⁄ ₄ " Birch Plywood	Steaming	\$75.00
3	Rocker	2	Recycled Stainless Break and form and ro Steel		\$15.00
4	Seat Saddle	1	100% Wool Felt from KVADRAT	Steaming	\$80.00
5	18-8 Stainless Steel Torx Flat Head Screw	8	Stainless Steel /		\$8.00
6	18-8 Stainless Steel Hex Nut	8	Stainless Steel	/	\$8.00
7	18-8 Stainless Steel Washer	16	Stainless Steel	/	\$4.00

POD

Item #	Description	Quantity	Material	Manufacturing Method	Price
1	Panel 1	1	³ / ₄ " Birch Plywood	Steaming	\$50.00
2	Panel 2	1	³ / ₄ " Birch Plywood	Steaming	\$50.00
3	Panel 3	1	³ / ₄ " Birch Plywood	Steaming	\$50.00
4	Panel 4	1	³ / ₄ " Birch Plywood	Steaming	\$50.00
5	Panel 5	1	³ / ₄ " Birch Plywood	Steaming	\$50.00
6	Panel 6	1	³ / ₄ " Birch Plywood	Steaming	\$50.00
7	Acoustic Interior	10 yards	100% Wool Felt from KVADRAT	Steaming	\$600.00
8	Desk Screen	1	LCD Display	Per Manufacturer's Specs	\$250.00
9	Vertical Curved SCreen	1	LCD Display	Per Manufacturer's Specs	\$500.00

Appendix I – Sustainability Info/Data

After looking at the existing materials and manufacturing methods, the design of the dyslexic pod is to be made of natural materials. Schools are slowly starting to add more natural materials into the classrooms allowing for students to feel more in tune with nature - opposed to using plastic materials. As well, when the opportunity arises, society should promote the use of non plastic materials. This is why plywood and wool upholstery has been chosen for use. With the concept behind the product family being to bring high levels of dyslexic support to the students in schools, the design and material selection of the pod should be five years ahead of its time - as this is the current trend of North American schools.

The use of wood, particularly plywood is commonly used and many have a positive experience using it as shown in the graph below.



Figure 8. Experience of wood products. GLT = glued-laminated timber, LDF/MDF/HDF = low/medium/high density fibreboards, PB = particleboard, OSB = oriented strand board, LVL = laminated veneer lumber, TMT = thermally modified timber, WFI = wood fibre insulation board, CLT = cross-laminated timber, WPC = wood plastic composite, PSL/LSL = parallel/laminated strand lumber.

Retrieved from: https://www.tandfonline.com/doi/pdf/10.1080/17480272.2019.1600164

Appendix J – Approval Forms & Plans

IDSN 4002 SENIOR LEVEL THESIS ONE

Humber ITAL / Faculty of Applied Sciences & Technology Bachelor of Industrial Design / FALL 2022 Catherine Chong / Frederic Matovu

THESIS TOPIC APPROVAL:

Student Name:	Harry Cotaras
Topic Title:	How may we improve the learning experience for dyslexic children aged eight to twelve?

TOPIC DESCRIPTIVE SUMMARY (PRELIMINARY ABSTRACT)

Reading and writing are fundamental skills for every child to be successful in our society. With developmental dyslexia (simply referred to dyslexia hereon in) affecting 15% - 20% of Canada's population, the need is there to make sure every child is able to read and write well. Young dyslexic children aged eight to twelve are especially prone to experiencing the frustrations learning to read gives. Diagnosing dyslexics at a younger age is the first step for intervention, with extra help in phonological training, and comprehending what is being read following immediately after. While there is assistive technology for helping learn to read, helping comprehend what is being read, and speech to text - there is no one product that leaders in this field recommend to inexperienced and anxious parents. Through interviews, observational studies of 1:1 tutoring sessions, and previous scholarly research, this thesis is intended on providing an evidence based multisensory design to help struggling dyslexic students.

Stude	ht Signature(s):
Date:	04 / 10 / 2022

Instructor Signature(s): Wherene Mong Date: 06 October 2022





Humber ITAL / Faculty of Applied Sciences & Technology Bachelor of Industrial Design / WINTER 2023 Catherine Chong / Fredric Matovu

CRITICAL MILESTONES: APPROVAL FOR CAD DEVELOPMENT & MODEL FABRICATION

Student Name:	Harry Cotaras
Approved Thesis Title:	Improving Dyslexic Children's Learning Experience

THESIS PROJECT - DESIGN APPROVAL FORM

Design is r to proceed	eviewed and approved for the following:	X	CAD Design and Development Phase
Comment:	Continue design refinement in CAD deve	elopme	nt, need to iron out detailing and product's
	features, pay attention to surfacing, com	ponent	s, and assembly methods for design feasibility.
	Viable holistic design thinking in conjunc	tion wit	th considerations into sustainability aspects.
	CAD development must be at least 75%	comple	ete for review before approval for fabrication.

Design is r to proceed	eviewed and approved for the following:	X	Model Fabrication Including Rapid Prototyping / 3D Printing and Model Building Phase
Comment:	Waiting for CAD development review (as	s of Fe	b-21).
	CAD progress well, design completed, c fabrication of model can begin.	ontinu	e detail refinement, once refined,

Instructor Signature(s):		
atherine	Marg F.K. Matory	
Date:	07 March 2023	

Chong, Kappen

me, Thelma 2	Hi! - thelma@srlcfc.com> Subject: Hi! Hi Thelma, Hope everything is going well with you and the learning c	Nov 15
me, Thelma 4	Advisor - thelma@srlcfc.com> wrote: Here you go! Talk soon, Thelma From: Harry Cotaras <harrycotaras@ brn3c2af4bc="" conse<="" informed="" td=""><td>Oct 12</td></harrycotaras@>	Oct 12
me, Thelma 9	Surveys to Send Out - thelma@sricfc.com> Subject: Re: Surveys to Send Out Thanks Thelma, I've been ge	Oct 6
Thelma Gregan	just got this link in my email! - https://dyslexiaida.org/instructional-and-assistive-technology-maximizing-t	Oct 6
Thelma Gregan	Evaluation for Dyslexia.docx - I'm getting ready for training in Calgary and we are talking about the testing	Sep 30
Thelma Gregan	Mobile Apps That Support the Science of Reading and Writing_David Winters (1).docx - Datedbut I expe Mobile Apps Th	Sep 30
Thelma, me 2	update - thelma@srlcfc.com> wrote: Good Morning! We are still without power at the Centre and I am hea	Sep 28
Thelma Gregan	getting you connected - Harry, meet Michael and Barbara Baxter, the Directors of the Scottish Rite Learni	Sep 27
me, Thelma 2	Learning Centers In Ontario - I will make the Hamilton connection. It's in my list. The next closest is Barrie	Sep 27
Thelma Gregan	FW: Join us on September 29 at 7pm EDT for our back to school session 📚 - I haven't forgotten about you	Sep 26
Thelma Gregan	getting you connected - Harry and Jill, meet one another! Harry's thesis topic is right up your alley, Jill: "	Sep 25
Thelma Gregan	a couple of quick links for you to explore - https://www.greatwordhouse.com/evelyn-reiss/ https://susanba	Sep 23

Advisor Initiatives

Research Plan

Research - 1:1 Interview w/ tutor

Questions These are conversation starters, as the interview progress new and more in depth questions will arise.

What are the top challenges you face as a tutor?

What are the top trends related to assistive technology?

Do you know of any impact emerging technologies have?

What are the largest opportunities for helping dyslexics learn to read?

Interview will be conducted Wednesday October 5th via phone call.

Project Timeline



Appendix K – Advisor Meetings & Agreement Form



Project Information

Thank you very much for your time and help in making this study possible. If you have any queries or wish to know more about this Senior Level Thesis project, please contact me at the followings:

Phone: 902.219.4776

Email: harrycotaras@gmail.com

My supervisor is:

Prof. Catherine Chong, catherine.chong@humber.ca

IDSN 4002 /4502

SENIOR LEVEL THESIS ONE & THESIS TWO

🕐 HUMBER

Faculty of Applied Sciences & Technology Bachelor of Industrial Design / FALL 2022 &

PARTICIPANT INFORMED CONSENT FORM

Research Study Topic:	Improving the Learning Experience for Dyslexic Children aged 8-12
Investigator:	Harry Cotaras / harrycotaras@gmail.com / 902.219.4776
Courses:	IDSN 4002 & IDSN 4502 Senior Level Thesis One & Two

I, Therma Gregan, have carefully read the Information Letter for the project pertaining to dyslexia in children aged eight to twelve, led by Harry Cotaras. A member of the research team has explained the project to me and has answered all my questions about it. I understand that if I have additional questions about the project, I can contact Harry Cotaras at any time during the project.

I understand that my participation is voluntary and give my consent freely in voice recording, photography and/or videotaping; with the proviso that my identity will be blurred in reports and publications.

Consent for Publication: Add a (X) mark in one of the columns for each activity				
ACTIVITY		YES		
Publication	I give consent for publication in the Humber Library Digital Repository which is an open access portal available to the public	Ø		

Publication I give consent for publication in the Humber Library Digital Repository which is an open access portal available to the public Image: Consent for review by the Professor Image: Consent for review by the Professor Review I give consent for review by the Professor Image: Consent for review by the Professor Image: Consent for review by the Professor

Privacy

All data gathered is stored anonymously and kept confidential. Only the principle investigator /researcher, Harry Cotaras and Prof. Catherine Chong or Prof. Frederick Matovu may access and analyze the data. All published data will be coded, so that visual data is not identifiable. Pseudonyms will be used to quote a participant (subject) and data would be aggregated.

I also understand that I may decline or withdraw from participation at any time, without negative consequences.

I understand that I can verify the ethical approval of this study, or raise any concerns I may have by contacting the Humber Research Ethics Board, Dr. Lydia Boyko, REB Chair, 416-675-6622 ext. 79322, Lydia.Boyko@humber.ca or Harry Cotaras, harrycotaras@gmail.com, 902.219.4776.

Verification of having read the Informed Consent Form:

I have read the Informed Consent Form.

My signature below verifies that I have read this document and give consent to the use of the data from questionnaires and interviews in research report, publications (if any) and presentations with the proviso that my identity will not be disclosed. I have received a copy of the Information Letter, and that I agree to participate in the research project as it has been described in the Information Letter.

Thelma Gregan

Participant's Name

articipant's Signature

11 October, 2022 Date

NO

3

Record of Correspondence

me, Thelma 2	Hi! - thelma@srlcfc.com> Subject: Hi! Hi Thelma, Hope everything is going well with you and the learning c	Nov 15
me, Thelma 4	Advisor - thelma@srlcfc.com> wrote: Here you go! Talk soon, Thelma From: Harry Cotaras <harrycotaras@ brn3c2af4bc="" conse<="" informed="" td=""><td>Oct 12</td></harrycotaras@>	Oct 12
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Thelma Gregan	just got this link in my email! - https://dyslexiaida.org/instructional-and-assistive-technology-maximizing-t	Oct 6
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me, Thelma 2	Learning Centers In Ontario - I will make the Hamilton connection. It's in my list. The next closest is Barrie	Sep 27
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Thelma Gregan	getting you connected - Harry and Jill, meet one another! Harry's thesis topic is right up your alley, Jill: "	Sep 25
Thelma Gregan	a couple of quick links for you to explore - https://www.greatwordhouse.com/evelyn-reiss/ https://susanba	Sep 23

Appendix L – Other Supportive Raw Data

Child Lesson Plan during an Orton-Gillingham class.

Child: Maggie Frank			Tutor: San	an Mckee	bale: october 10,				
ew Goal:	vowel team o	y boy /oi/			Lesson #:89				
eview Goals	s: oi /oi/, suf	ffix -sion, -tion	n, ou/ow spellin	g generalization, vowel	Car	ah mh	meter		
ams, au, ay	, ea,ey,oa,oe,	,00 0U, OW			200	0.00	ail. (cr		
ast Lessons	s: oi /oi/, sut	ffix -sion, -tio	n, ou/ow spellin	g generalization, vowel		C 3.			
ams, au, ay	, ea,ey,oa,oe	,00 0U, 0W							
svel	a-e(ā), a((ō),oe, (ō),	ă, ā), ai (ā), ay oi (oi), oo (oo.	(ā), ar, e-e (ē b/oo/k) or, ou	:),e,(ē, ĕ),ea (ē), ee (ē) er (ou) ow(ō,ou) u-e (ū, oo) u	r, ey (ē) i - e (ī), i(ī, ī),i ı, (ŭ, ū, oo), ur y (ī,ē)	r, o-e (õ) o(õ, õ),	oa		
	b, c, ch, ck	, d, f,ff, g, h,	j, k, l, ll,m, n, p,	qu, r, s(s,z), ss,sh, t, tch	, th, v, w, wh, x,y, z,zz				
hunks	all, am, an,	ang,ank, ild, in	nd, ing,ink, old,	olt, ost, ong, onk,quar, ur	ng, unk,war, wor	washe compared	worde		
oncepts	consonant,	vowel, (short	vowel sounds)	syllable, digraphs, chunks	, consonant blends, trig	propris, compound	words		
pelling	flsz ,cat, k	-ck, ch-tch, er	r, ic,ve,ai-ay,ct	, ou-ow					
yliables	closed, v-e	e, open, r-contr	rolled, vowel tea	m					
refixes	14.1.1	A)	alan Alan						
uffixes	-ed (ed, d,	T), -er, -ing, -s	s,-sion,-tion, -y		100 m 100 m 10 m 10 m 10 m 10 m 10 m 10				
atin Roots	-ject, -por	ectiver weeks	nucr - mact,	nse homonyms					
remmar	nouns, day	ectives, verbs	, piurai, pasi re	nse, nomonyms					
Alable Div	vision Patte	rns Taught							
	VC/CV reb/bit	VG/Cve in/hole	VCCCV	V-e -side/burn compound words - hot/	/dog ti/gen	VC/V cam/el	V/V li/on		
			Sec	tion One - 20 Min	utes				
nonogran Ass	n Review essment		Sec	tion One - 20 Min	utes				
nonogram Ass	n Review		Sec	tion One - 20 Min	utes				
nonogram Ass lending [n Review essment Drill		Sec	tion One - 20 Min	utes				
nonogram Ass ending [Ass	n Review essment Drill essment		Sec	tion One - 20 Min	utes				
nonogran Ass lending [Ass ntro New	n Review essment Orill essment w Work -	Guided Di:	Sec scovery	tion One - 20 Min	utes				
nonogran Ass dending [Ass ntro New	n Review essment Drill essment w Work -	Guided Di	Sec	tion One - 20 Min	utes				
nonogran Ass lending [Ass ntro New Pre	n Review essment Drill essment w Work - Review	Guided Di	Sec scovery	tion One - 20 Min	utes				
nonogram Ass lending [Ass ntro New Pre vow vow vow vow	n Review essment Drill essment w Work - -Review el at the end el is followed king togethe	Guided Dis A word or p vowel sound i by a consonar r to make a vo	Sec scovery (Super 6: r is long; closed = nt(s) and a fina wel sound) a i (ā), ay (ā	tion One - 20 Min with a talking vowel. controlled= vowel follow one vowel closed in by a I silent e, the vowel sound), ea (ē), ee (ē), ey (ē), o	utes ed by r, r controlled vo consonant(s) vowel sou d is long. Vowel team -i a (õ), oe(õ), oi (oi) oo (o	wel sound; open nd is short; v-e more than one va so) oo (b/ook/) o	= one = one swel sw (ō),		
nonogran Ass lending [Ass ntro New vow vow vow vow vow vow	n Review essment Drill essment w Work - -Review el at the end el is followed king togethe ww) ditory	Guided Dis A word or p by a consonar r to make a vor	Sec scovery (Super 6: r s long: closed = nt(s) and a fina wel sound) ai (ä), ay (ä	tion One - 20 Min with a talking vowel. controlled= vowel follow one vowel closed in by a I silent e, the vowel sound), ea (ē), ee (ē), ey (ē), o	utes ed by r, r controlled vo consonant(s) vowel sou d is long. Vowel team - na (õ), oe(õ), oi (oi) oo (o	wel sound; open nd is short; v-e more than one va bo) oo (b/ook/) a	= one = one swel sw (ō),		
nonogran Ass ending I Ass ntro New vow vow vow vow vow	n Review essment Drill essment w Work - Review el at the end el is followed king togethe ww) ditory	Guided Dis A word or p yowel sound i by a consonar r to make a vor oi	Sec scovery (Super 6: r s long; closed = nt(s) and a fina wel sound) a i (a), ay (a y, soy	tion One - 20 Min with a talking vowel. controlled= vowel follow one vowel closed in by a I silent e, the vowel sound), ea (ē), ee (ē), ey (ē), o	ed by r, r controlled vo consonant(s) vowel sou d is long. Vowel team -i na (ō), oe(ō), oi (oi) oo (o	wel sound; open nd is short; v-e more than one va bo) oo (b/ook/) a	= one = one swel sw (ā),		
ending L Ass ntro New vow vow vow vow	n Review essment Drill essment w Work - -Review el at the end el is followed king togethe sw) ditory	Guided Dis A word or p , vowel sound i I by a consonar r to make a vor oi	Sec scovery (Super 6: r s long: closed = nt(s) and a fina wel sound) a i (ā), ay (ā	tion One - 20 Min with a talking vowel. controlled= vowel follow one vowel closed in by a I silent e, the vowel sound), ea (ē), ee (ē), ey (ē), o	utes ed by r, r controlled vo consonant(s) vowel sou d is long. Vowel team -t a (ō), oe(ō), oi (oi) oo (c	wel sound; open nd is short; v-e more than one va bo) oo (b/ook/) a	= one = one bwel bw (0),		
ending I Ass ntro New vow vow vow vow vow vow vow vow vow vo	n Review essment Drill essment w Work - -Review el at the end el is followed king togethe bw) ditory	Guided Dis A word or p vowel sound i by a consonar r to make a vor oi boy, joy /oi/	Sec scovery (Super 6: r is long; closed = nt(s) and a fina wel sound) ai (ä), ay (ä	tion One - 20 Min with a talking vowel. controlled= vowel follow one vowel closed in by a I silent e, the vowel sound), ea (ë), ee (ë), ey (ë), o	utes ed by r, r controlled vo consonant(s) vowel sou d is long. Vowel team -r na (ö), oe(ö), oi (oi) oo (c	wel sound; open nd is short; v-e more than one va bo) oo (b/ook/) a	= one = one pwel pw (ō),		
ending L Ass ntro New vow vow vow vow vow vow vow vow vow vo	n Review essment Drill essment w Work - -Review el at the end el is followed king togethe ww) ditory	Guided Dis A word or p , vowel sound i I by a consonar r to make a vor oi oi	Sec scovery oart of a word of (Super 6: r is long; closed = nt(s) and a fina wel sound) ai (ä), ay (ä y, soy	tion One - 20 Min with a talking vowel. controlled= vowel follow one vowel closed in by a I silent e, the vowel sound), ea (ē), ee (ē), ey (ē), o	ed by r, r controlled vo consonant(s) vowel sou d is long. Vowel team -t a (ō), oe(ō), oi (oi) oo (c	wel sound; open nd is short; v-e more than one va bo) oo (b/ook/) a	= one = one bwel bw (0),		
ending L Ass ntro New vow vow vow vow vow vow vow vow vow vo	n Review essment Drill essment w Work - -Review el at the end el is followed king togethe ww) ditory	Guided Dis A word or p , vowel sound i I by a consonar r to make a vor oi oi	Sec scovery oart of a word of (Super 6: r s long; closed = nt(s) and a fina wel sound) ai (ä), ay (ä y, soy	tion One - 20 Min with a talking vowel. controlled= vowel follow one vowel closed in by a l silent e, the vowel sound), ea (ē), ee (ē), ey (ē), o oy (Maggie to underli	utes ed by r, r controlled vo consonant(s) vowel sou d is long. Vowel team -t na (ō), oe(ō), oi (oi) oo (c	wel sound; open nd is short; v-e more than one va bo) oo (b/ook/) a	= one = one bwel bw (0),		

*Introduce new card with a picture or prop that supports key word		
Kinesthetic		
Trace 3 x 3 ways: oy boy /oi		
Mini blending drill with new card		

Assessment

New Word List - Re-read for fluency. Discuss interesting words*

coy*	toy / boy	ploy*	decoy*	enjoy
bellboy*	Troy	convoy	employ	batboy*

Assessment

New Word Sentences - Re-read for fluency. Discuss interesting words*

The cowboy trussed* up the wild jumping pig at the fall fair.

- 2. Floyd was deployed* to instruct the troops overseas.
- 3. Roy was overjoyed to see that so many people came to her birthday party.

Assessment

Phonemic Awareness/Multi-Sensory Elements/Fluency - 2 minutes

What is a phoneme? (The smallest unit of sound) How many phonemes (sounds) do you hear in each word? (tap /discs) wax, steam, quick, glad, stop, stay, mix, beehive, soup,

Assessment

Review Word List - Re-read for fluency. Discuss interesting words*

toyshop	soymilk	oyster	annoy	
broiled	functions	rowboat	patchwork quilt	
depression	intentions	scouted*	*toiling	
ostrich	transfusion*	spoiling	beefsteak	

Assessment

Learned Words one/won, buy/by

Level I	the	said DW1:13	ā	are	was DW 1:17	were	to	do bw1:3	of	put	love DW1:67	who DW1:19	
Level Ii	one DW1: 33	two DW1: 16	once DW1:33	come DW1:14	some DW1:14	does DW1:3	done DW1:3	gone DW1:3	they DW1:15	what			
Level Iii	there DW 1: 5	would DW1:23	have	where DW 1: 5	should DW1:23	again DW1:1	any DW1:21	could DW1:23	been DW1:31	many DW1:21	Says DW1:12	ogainst DWI:1	give DW1:20
Level Iv	sure DW2:20	buy DW1:24	enough	sugar DW2:20	build bw:33	their DW1:15	friend DW1:35	though DW2:8	people DW1:60	tough	walk DW1:25	talk DW1:25	chalk DW1:25

Updated March 201

Section Two - 20 Minutes

What Says? Child reads the list back, sounds only. VOWAC oi/oy

Say	What says	Say	What Says?	Say	What says?	Say	What Says?	Say	What Says?
/oi/	oi, oy	b/oo/k	00	/shun/	-tion, -sion	/1/	i-e, vowel y, i	/ 0/	u, u-e
/ou/	ou, ow	181	ey,ea,-y, ee, e, e- e,vowel y	/ ō/	0, 0-8, 00, 06, ow	/k/	c,k,ck	/ ā/	a,a-e, ai, ay
/00/	u-e,u, oo	KI	i	/ĕ/	e	/zhun/	-sion	/er/	er, ir, ur, -er

Assessment_______S. O. S. Child reads word list back. Discuss interesting words*

Sequence:					
Tutor: says "word"					
Child: repeats: "word"					
Child: "builds word" usin	g felt to show syllables	s, prefixes, suffixes, Lati	n roots		
Child: taps out sounds (use 1 chip/finger per s	ound)			
Child: taps out letters					
Child: spells letters who	en writing out the word				
Child: reads the word o	ut loud				
Child: rereads the list of	of spelled words				
employed	toybox	aruntina	outside	sprayed	trunk

Assessment

Sentence Dictation Discuss interesting words*

1.	In the fall the farmer employed many workers to harvest his soybeans and grain.	Sequence: Tutor says sentence.
2.	The decoys were put in the pond to fool the ducks at the start of the hunting party.	Child independently writes Sentence. Child reads sentence out loud
3.	The wild child took the car for a quick joyride without telling her friend,	Child corrects sentence using C(apitals) A(appearance) P(unctuation) S(celling)

Assessment

Updated March 201

	(water at most be 55% decodable - aways use now	concept)
TBD		
Asses	ment	
riting	(Somewhere during the lesson)	
Asse:	sment	
Rev	ew Key Points - Brief wrap up - under two minutes!	
oy b	y /oi/	
Ne	ct Lesson Plan -	
eg.	/hat will be beneficial to review next lesson? What new wind generalization: gi/gy	vork will be in next lesson?
Spe	ing generalization of of	
Subj	ctive (How was child in lesson; focused? late? bo	ored? tired? on task? attentive?)
Subj	ctive (How was child in lesson; focused? late? be	ored? tired? on task? attentive?)
Subj	ctive (How was child in lesson; focused? late? be	ored? tired? on task? attentive?)
Subj	ctive (How was child in lesson; focused? late? ba	ored? tired? on task? attentive?)
Subj	ctive (How was child in lesson; focused? late? ba	ored? tired? on task? attentive?)
Subj	ctive (How was child in lesson; focused? late? by	ored? tired? on task? attentive?)
5ubj	ctive (How was child in lesson; focused? late? b	ored? tired? on task? attentive?)

130

Appendix M – Topic Specific Data, Papers, Publications

The following is the first page for a paper that speaks on the font choices that work best for dyslexics.

Good Fonts for Dyslexia

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ABSTRACT

Around 10% of the people have dyslexia, a neurological disability that impairs a person's ability to read and write. There is evidence that the presentation of the text has a significant effect on a text's accessibility for people with dyslexia. However, to the best of our knowledge, there are no experiments that objectively measure the impact of the font type on reading performance. In this paper, we present the first experiment that uses eye-tracking to measure the effect of font type on reading speed. Using a within-subject design, 48 subjects with dyslexia read 12 texts with 12 different fonts. Sans serif, monospaced and roman font styles significantly improved the reading performance over serif, proportional and italic fonts. On the basis of our results, we present a set of more accessible fonts for people with dyslexia.

Keywords

Dyslexia, font types, typography, readability, legibility, text layout, text presentation, eye-tracking.

1. INTRODUCTION

Worldwide, around 15-20% of the population has a language based learning disability [17]. Likely, 70-80% of them have dyslexia [17], a neurological disability which impairs a person's ability to read and write. Previous research has shown that text presentation can be an important factor regarding the reading performance of people with dyslexia [11, 25].

On the other hand, any digital text has to be written using one or several certain font types. Although the selection of font types is crucial in the text design process, empirical analyses of reading performance of people with dyslexia has focused more on font size [23, 26] rather than on font type. In this paper we present the first study that measures the impact of the font type on the reading performance of 48 people with dyslexia using eye-tracking, as well as asking them their personal preferences.

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The main contributions of this study are:

- Font types have a significant impact on readability of people with dyslexia.
- Good fonts for people with dyslexia are *Helvetica*, *Courier*, *Arial*, *Verdana* and *Computer Modern Unicode*, taking into consideration reading performance and subjective preferences. On the contrary, *Arial It.* should be avoided since it decreases readability.
- Sans serif, roman and monospaced font types increased the reading performance of our participants, while *italic* fonts did the opposite.

Next section focuses on dyslexia, while Section 3 reviews related work. Section 4 explains the experimental methodology and Section 5 presents the results, which are discussed in Section 6. In Section 7 we derive recommendations for dyslexic-friendly font types and we mention future lines of research.

2. DYSLEXIA

Dyslexia is a hidden disability. A person with dyslexia cannot perceive if they are reading or writing correctly. Dyslexia is characterized by difficulties with accurate word recognition and by poor spelling and decoding abilities [16]. This implies that people with dyslexia have more difficulty accessing written information and, as side effect, this impedes the growth of vocabulary and background knowledge [16]. Popularly, dyslexia is identified with its superficial consequences, such as writing problems like letter reversals; but dyslexia is a reading disability with a neurological origin. Brain structure, brain function, and genetics studies confirm the biological foundations of dyslexia [31].¹ Although dyslexia is also popularly identified with brilliant famous people, such as Steve Jobs or Steven Spielberg, the most frequent way to detect a child with dyslexia is by low-performance in school [4]. Moreover, dyslexia is frequent. From 10 to 17.5% of the population in the U.S.A. [15] and from 8.6 to 11% of the Spanish speaking population [18] have this cognitive disability. The frequency and the universal neuro-cognitive basis of dyslexia are the main motivations of this study.

¹Despite its universal neuro-cognitive basis, dyslexia manifestations are variable and culture-specific [31].

The Ontario Right to Read report cover and introduction page. This public inquiry is of recent years (October 3rd 2019) and is proving to bring about new policies.



Introduction

The right to equal education includes the right to read

On November 9, 2012, the Supreme Court of Canada released a unanimous decision recognizing that learning to read is not a privilege, but a basic and essential human right. The Supreme Court found that Jeffrey Moore, a British Columbia student with dyslexia, had a right to receive the intensive supports and interventions he needed to learn to read. The school board's failure to provide special education programs and services, including intensive intervention, denied Jeffrey Moore meaningful access to education, resulting in discrimination under the British Columbia *Human Rights Code*. The Court said:

...adequate special education...is not a dispensable luxury. For those with severe learning disabilities, it is the ramp that provides access to the statutory commitment to education made to *all* children...

The *Moore v British Columbia (Education)* decision (*Moore*) confirmed that human rights laws in Canada protect the right of all students to an equal opportunity to learn to read. This decision was lauded as a significant victory for students with disabilities, particularly students with reading disabilities. Many hoped that it would act as a catalyst for systemic change in Ontario's education system.

Almost 10 years after the *Moore* decision, the Ontario Human Rights Commission (OHRC) released a report on its public inquiry into the right to read. The right to read applies to ALL students, not just students with reading disabilities. This inquiry found that Ontario is not fulfilling its obligations to meet students' right to read.

Despite decades of multi-disciplinary research on what is most effective for teaching students early reading skills, and after *Moore* affirmed that meaningful access to education, including learning to read, is a human right, Ontario is systematically failing students with reading disabilities and many other students. The promise of *Moore* has not been fulfilled. This leaves many students at risk for significant life-long difficulties. The inquiry is not just about an equal right to read – it is about an equal right to a future.